

AD744307

FOREIGN TECHNOLOGY DIVISION



3. THE INFLUENCE OF SOME ADDITIONS ON THE PROPERTIES OF GLASSES IN THE SYSTEM $\text{SiO}_2\text{-Al}_2\text{O}_3\text{-MgO-CaO}_3$

by

N. N. Yermolenko, I. K. Nemkovich, and I. L. Rakov



Approved for public release;
distribution unlimited.

10

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body or abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author) Foreign Technology Division Air Force Systems Command U. S. Air Force		2a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED
		2b. GROUP
3. REPORT TITLE 3. THE INFLUENCE OF SOME ADDITIONS ON THE PROPERTIES OF GLASSES IN THE SYSTEM $\text{SiO}_2\text{-Al}_2\text{O}_5\text{-MgO-CaO}$		
4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Translation		
5. AUTHOR(S) (First name, middle initial, last name) Yermolenko, N. N. ; Nemkovich, I. K.; and Rakov, I. L.		
6. REPORT DATE 1963	7a. TOTAL NO. OF PAGES 6	7b. NO. OF REFS
8a. CONTRACT OR GRANT NO.	8b. ORIGINATOR'S REPORT NUMBER(S)	
9a. PROJECT NO.	9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) FTD-MT-24-1257-71	
10. DISTRIBUTION STATEMENT	Approved for public release; distribution unlimited.	
11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY Foreign Technology Division Wright-Patterson AFB, Ohio	

Results are presented from a study of the influence of given glass additions and fluorine on the physicochemical properties of glass 5/10, lying in the most readily fusible range of a given system, and two glasses having the identical molar content of oxides MgO and CaO . Crystallization capacity and the influence of additions on softening temperature and thermal expansion are given.

I

DD FORM 1 NOV 65 1473

UNCLASSIFIED

Security Classification

Security Classification

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Thermal Expansion Glass Silica Oxide						

II

UNCLASSIFIED

Security Classification

EDITED MACHINE TRANSLATION

3. THE INFLUENCE OF SOME ADDITIONS ON THE PROPERTIES
OF GLASSES IN THE SYSTEM $\text{SiO}_2\text{-Al}_2\text{O}_3\text{-MgO-CaO}$

By: N. N. Yermolenko, I. K. Nemkovich, and I. L. Rakov

English pages: 6

Source: Belorusskiy Politekhnicheskiy Institut
(Belorussian Polytechnical Institute),
Minsk, 1963, pp. 28-32.

This document is a SYSTRAN machine-aided translation, post-edited for technical accuracy by:
Charles T. Ostertag.

Approved for public release;
distribution unlimited.

UR/0000-63-000-000

THIS TRANSLATION IS A RENDITION OF THE ORIGINAL FOREIGN TEXT WITHOUT ANY ANALYTICAL OR EDITORIAL COMMENT. STATEMENTS OR THEORIES ADVOCATED OR IMPLIED ARE THOSE OF THE SOURCE AND DO NOT NECESSARILY REFLECT THE POSITION OR OPINION OF THE FOREIGN TECHNOLOGY DIVISION.

PREPARED BY:

TRANSLATION DIVISION
FOREIGN TECHNOLOGY DIVISION
WP-AFB, OHIO.

3. THE INFLUENCE OF SOME ADDITIONS ON THE PROPERTIES OF GLASSES IN THE SYSTEM $\text{SiO}_2\text{-Al}_2\text{O}_3\text{-MgO-CaO}$

N. N. Yermolenko, I. K. Nemkovich,
and I. L. Rakov

The glasses of this system can be obtained from inexpensive and non-scarce raw materials: sand, kaolin, dolomite, and chalk. Furthermore they possess a number of very valuable properties because they do not contain the oxides of alkali metals.

In the work described in the present section a study was made of the influence of additions of P_2O_5 , TiO_2 , ZrSiO_4 , Cr_2O_3 , and fluorine on the physicochemical properties of glass 6/10, lying in the most readily fusible range of the system $\text{SiO}_2\text{-Al}_2\text{O}_3\text{-MgO-CaO}$ [42], and two glasses having the identical molar content of oxides MgO and CaO [43].

The chemical compositions of the initial glasses are shown in Table 11.

The glasses were cooked in quartz crucibles with a capacity of 1 liter in kerosene furnace at temperature of 1450-1460° for 5-6 hours. The composition 6/10 with the addition of 2 and 2.5 g Cr_2O_3 per 100 g of glass was crystallized during development. This same composition upon introduction into it of 1-5 g of P_2O_5

Table 11

(2) Номер стекла	(1) Состав стекла, мол. %			
	SiO ₂	Al ₂ O ₃	MgO	CaO
6/10	45	10	15	30
12	50	10	20	20
16	45	5	25	25

KEY: (1) Composition of glass,
mole %; (2) Number of glass.

gives opal glass. Crystallized glasses were also obtained on the basis of compositions 12 and 16 with additions of 1-5 g of Cr₂O₃, and also composition 16 with the addition of 4-5 g of TiO₂ per 100 g of glass. Under the indicated conditions the remaining compositions were welded well. The glasses obtained were thoroughly annealed.

Crystallization capacity was determined in a gradient furnace by the method of I. F. Ponomarev.

The temperature of the onset of softening was established based on the beginning of the immersion of a needle into the sample of glass during its heating. Thermal expansion was studied with the help of a quartz dalatometer designed by the Glass Institute.

The results of the determination of crystallization capacity, softening temperature, and thermal expansion are shown in Figs. 13-16.

The chemical resistance of experimental glasses was determined with respect to water. A suspension of powdered glass with grain sizes from 0.25 to 0.5 mm was held in 100 ml of boiling water for five hours. Water resistance was evaluated according to the loss of weight of the powder during the experiment and was expressed in percentages with respect to its original weight.

All glasses were sufficiently resistant against water. The losses of weight during the test comprised 0.02-0.16%.

As can be seen from the drawings, additions of P_2O_5 , $ZrSiO_4$, TiO_2 and Cr_2O_3 do not exert a noticeable influence on the softening temperature of experimental glasses in the system $SiO_2-Al_2O_3-MgO-CaO$; the introduction of fluoride compounds AlF_3 and Na_2SiF_6 into the glass compositions causes a significant lowering in this property. These additions influence the thermal expansion of alkali-free glasses somewhat differently. A lowering in the thermal expansion of initial glasses is caused by additions of $ZrSiO_4$. Phosphorus oxide and the chromic oxide, on the contrary, increase the expansion coefficient of the alkali-free glasses studied.

The behavior of additions of TiO_2 , Na_2SiF_6 , and AlF_3 in the glass depends on the content of aluminum oxide in it. In glasses with 10 mole % Al_2O_3 additions of AlF_3 and Na_2SiF_6 lead to a certain increase, and TiO_2 barely changes the thermal expansion of the glass. In glass containing 5 mole % of aluminum oxide TiO_2 causes a pronounced decrease, and Na_2SiF_6 at first facilitates an insignificant lowering, and then an increase in the expansion coefficient of experimental glass.

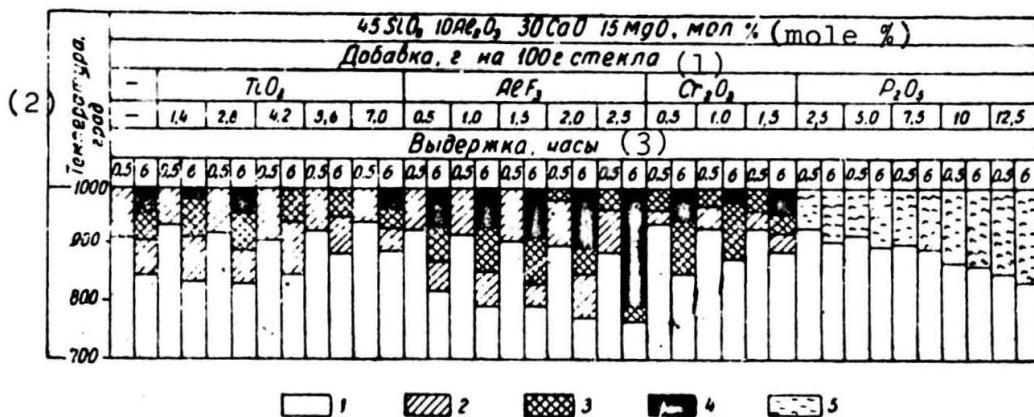


Fig. 13. The crystallization capacity of glass 45 SiO₂, 10 Al₂O₃, 30 CaO, 15 MgO (mole %) with additions of P₂O₅, TiO₂, Cr₂O₃, and AlF₃. 1 - no crystallization; 2 - crystalline film; 3 - crystalline shell; 4 - complete crystallization; 5 - opalescence. KEY: (1) Addition, g per 100 g of glass. (2) Temperature, deg. (3) Time lag, hours.

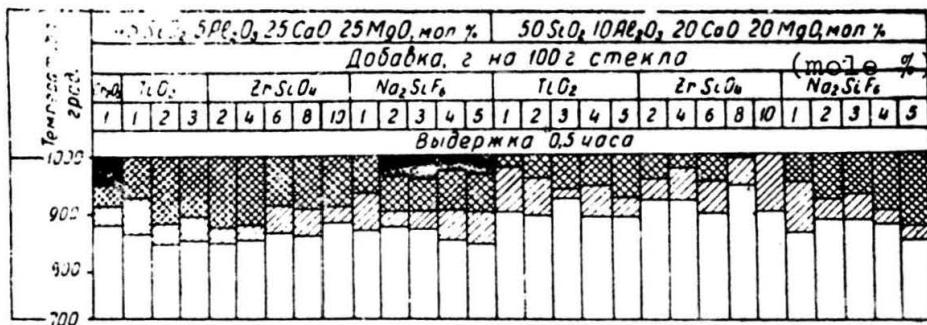


Fig. 14. The crystallization capacity of glass 45 SiO₂, 5 Al₂O₃, 25 CaO, 25 MgO, and 50 SiO₂, 10 Al₂O₃, 20 CaO, 20 MgO (mole %) with additions of TiO₂, ZrSiO₄, and Na₂SiF₆ with time lag of 0.5 hours (designations the same as in Fig. 13).

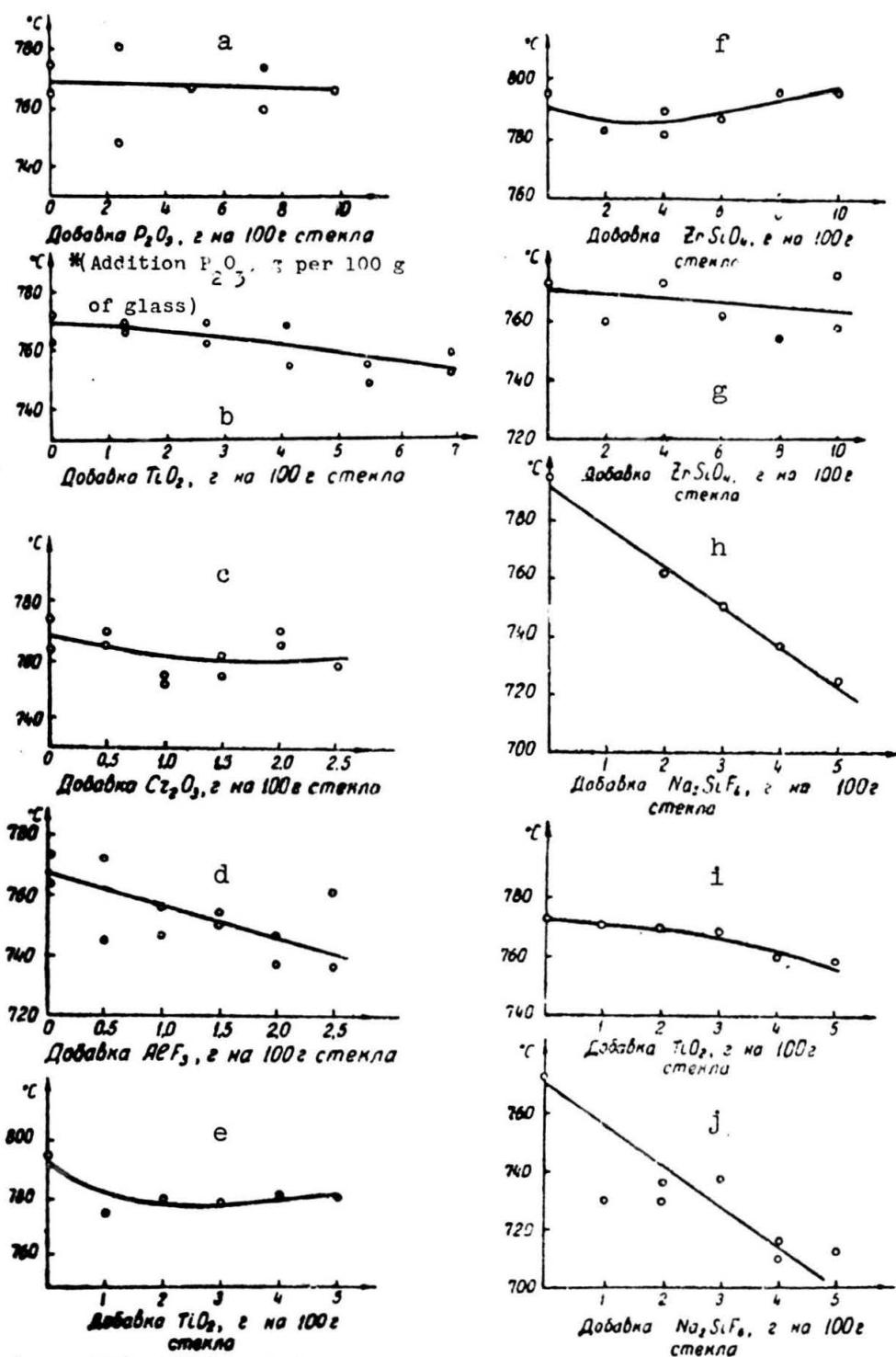


Fig. 15. The influence of additions on the softening temperature of glasses in the system $SiO_2-Al_2O_3-MgO-CaO$: a, b, c, d - 45 SiO_2 , 10 Al_2O_3 , 15 MgO, 30 CaO; e, f, g, h - 50 SiO_2 , 10 Al_2O_3 , 20 MgO, 20 CaO; i, j - 45 SiO_2 , 5 Al_2O_3 , 25 MgO, 25 CaO (mole %).

*Translator's note: Same heading for each of the ten graphs. The only change is the chemical compound.

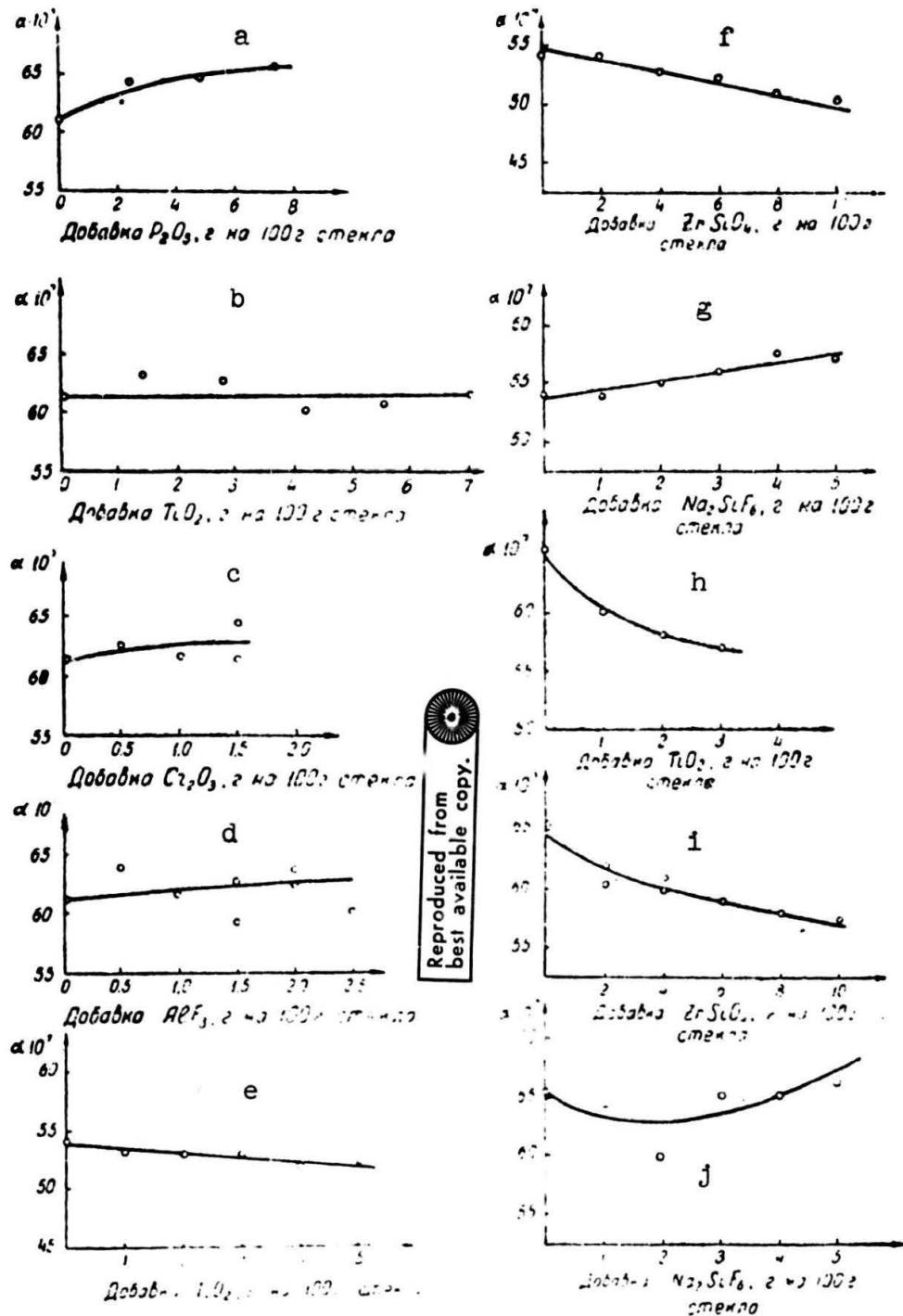


Fig. 16. The influence of additions on the thermal expansion of glasses in the system $\text{SiO}_2\text{-Al}_2\text{O}_3\text{-MgO-CaO}$: a, b, c, d - 45 SiO_2 , 10 Al_2O_3 , 15 MgO, 30 CaO; e, f, g - 50 SiO_2 , 10 Al_2O_3 , 20 MgO, 20 CaO; h, i, j - 45 SiO_2 , 5 Al_2O_3 , 25 MgO, 25 CaO (mole %). [Designations the same as in Fig. 15].